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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/917,912	07/31/2001	Masayuki Kojima	503.28546CV9	1412

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EXAMINER	
ANGEBRANNDT, MARTIN J	
ART UNIT	**PAPER NUMBER**
1756	

DATE MAILED: 04/16/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/917,912	KOJIMA ET AL.	
	Examiner	Art Unit	
	Martin J Angebranndt	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 January 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *8-15,17,27,67 and 68* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *8-15,17,27 and 67-68* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

1. The response provided by the applicant has been read and given careful consideration. Responses to the arguments offered by the applicant are presented after the first rejection to which they are directed. The obvious double patenting rejections are withdrawn based upon the filing of the proper terminal disclaimers. **The applicant may wish to assert that a single sample apparatus within the meanings of the claims is not merely a process line, but a series of connected chambers as shown in figures 3 and 11.**

2. The following is a quotation of 35 U.S.C. § 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.
>
> Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude Patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

3 Claims 8-15,17,27 and 67-68 are rejected under 35 U.S.C. § 103 as obvious over Elliot "Integrated Circuit Fabrication Technology" ©1982, in view of Nakamura et al. EP 0247603, Moe et al. '355, Peterman et al. '252 and Boswell '935.

Elliot specifically teaches on page **273**, the use of a carbon tetrafluoride plasma to preclean the wafer and harden the resist, the etching of the aluminum coated o the wafer using a carbon tetrachloride plasma to etch Al-Si, followed by a hydrogen plasma cleaning, a carbon tetrafluoride:Oxygen plasma. After this etching cycle the subsequent treatment with a wet etchant for aluminum is taught. The etching of an aluminum substrate using a carbon tetrachloride plasma:hydrogen etch, followed by a 60 second oxygen plasma passivation is taught on page **272**. The use of strippers to remove the resist after etching using solvents is disclosed on page 273 and 274. Page 57 teaches that after wet etching, rinsing and drying is conventional for aluminum layers. The use of nitric, phosphoric and acetic acid to perform the wet etch of aluminum is taught on pages 57,256 and 257. The use of rinsing and drying steps after resist removal using solvents is taught on page 58. Also conventional rinsing and drying after either wet or dry etching is taught on page 267. The minimization of exposure to the atmosphere which allows formation of HCl which subsequently etches the aluminum.

Nakamura et al. EP 0247603 teaches the use of an etchant gas for patterning the aluminum alloy layer formed on a glass substrate masked by the resist, followed by downstream etching/stripping of the resist pattern in an oxygen containing atmosphere, where **the substrate is transferred under an inert gas atmosphere or vacuum from the first etch apparatus to the second. (page 3/lines 27-53, hereinafter 3/27-53)** The use of this process with other alloys is disclosed. (4/57-58) The avoidance of exposure to the atmosphere is specifically taught (3/44-46)

Moe et al. '355 teach the use of either heated air or nitrogen to dry the wafers after stripping and rinsing. (1/32-36 and 49-56) Please note that the chamber in which the drying takes place is the same as the rinsing chamber. (see terminology rinse-dryer housing at 4/3).

Peterman et al. '252 teaches the dry etching using chlorine gas of various metallic contacts/interconnections. These include Al, Cu, Si, Ti,W,Ag,Au or alloys or **composites** of the preceding metals. (see claim 4 and 3/48-52).

Boswell '935 discloses that when using an RF bias applied to the substrate of the material being etched, the degree of the anisotropy of the etch may be controlled. The application of a low bias results in an isotropic etch while the application of a high RMS bias voltage results in an anisotropic etch (5/57-66). The use of this technique with reactive etch species, such as carbon tetrachloride is disclosed. (6/2-13)

It would have been obvious to one skilled in the art to add transferal of the substrate being process between different apparatus under vacuum as taught by **Nakamura et al. EP 0247603** and/or substitute the etching conditions disclosed for the metal films for those disclosed by **Elliot "Integrated Circuit Fabrication Technology" ©1982** with a reasonable expectation of success based upon their application in the same field and the direction within each of the references to minimize the exposure of the substrate to the atmosphere before the residual chlorine has been completely removed and that it would have been obvious to one skilled in the art to perform the rinsing and drying steps under a nitrogen atmosphere rather then in air in the processes of **Elliot "Integrated Circuit Fabrication Technology" ©1982** as modified by **Nakamura et al. EP 0247603**, based upon the teachings of **Moe et al. '355** that this is known in the art and the teachings of **Elliot "Integrated Circuit Fabrication Technology" ©1982** and

Nakamura et al. EP 0247603 to avoid exposure to air, and to apply an RF bias to the substrate during the etch process to control the anisotropy of the reactive ion etch as taught by **Boswell '935** and further adds that it would have been obvious to use the process disclosed by the combination of **Elliot "Integrated Circuit Fabrication Technology" ©1982, Moe et al. '355 and Nakamura et al. EP 0247603** with laminates which are composed of plural films of different metals forming a composite metallic film in place of the alloys of different metals disclosed by **Elliot "Integrated Circuit Fabrication Technology" ©1982 and Nakamura et al. EP 0247603** with a reasonable expectation of success based upon their similar reactivity to the etch in either form and the teaching of their equivalent function in the semiconductor art.

Clearly the teaching of Peterman et al. '252 teaches that alloys or composites of Al, Cu, Si, Ti,W,Ag,Au as well as the films of the elements themselves are able to be etched by chlorinated plasmas, similar to those disclosed by Elliot "Integrated Circuit Fabrication Technology" ©1982 and Nakamura et al. EP 0247603. This teaching is relied upon by the examiner to extend the teachings of these references from single layer films. The rejection is maintained and applied to new claims. Note the concern with the formation of corrosive residues within Elliot "Integrated Circuit Fabrication Technology" ©1982 and Nakamura et al. EP 0247603, which is the goal of the instant claims. The applicant also fails to appreciate that etching processes are etching processes and the rates are determined by the materials etched the mere addition of a resist mask can only have the obvious result of preventing etching of the covered areas. Additionally, there is no language in the instant claims concerning how the layers were formed on the substrate and therefore this is not a relevant issue to the instant claims.

The current claim language recites "... said first and second locations being capable of communication with each other through and atmosphere having a pressure reduced from atmospheric pressure ..." The full breadth of this appears to embrace both etch chambers being connected to etch other directly or via an intermediate chamber and both etch chambers being able to connect to the same transport chamber, but not mechanically linked together. This is also congruent with the language of dependent claims such as 45 which indicates that the etch chambers are closed off from the transport between them during etching and open to them otherwise.

The applicant argues that another examiner issued broader claims in US patent 5,868,854. **The examiner of the instant application points instead to the affirmance by the Board of Appeals in the parent application 08/470443 on 05/31/2001 applying the same or a similar rejection to that in the instant application. The examiner notes that generally, the opinion of the Board of Appeals carries more weight.** The applicant argues that transfer process between the two etching processes under vacuum is not taught in the prior art of record. **The examiner points to Nakamura et al. EP 0247603 which states "Next, the substrate 1 is transferred to a dry processing apparatus for stripping the patterned photo resist 3, passing through a vaccum system or an inert gas purged system, in order to avoid being exposed to the atmosphere. If the substrate is exposed to the atmosphere, the residual chlorine on the substrate reacts with water contained in the air and corrodes the alloy, as explained in the prior art." (3/42-46).** Not only does the prior art teach the invention as claimed, including the transfer between etch chambers under vacuum, but specifically teaches the same benefits as ascribed to it by the applicant. The whole idea of ashing the resist is to

remove it, therefore the arguments that the prior art does not teach the removal of the resist by the ashing process is entirely without merit. **What does the applicant construe "The patterned photo resist 3 on the patterned alloy layer 2' is then stripped by a known downstream etching methods. A stripping apparatus using microwave power, which is preferably employed in this stripping step, and is also called downstream etching or after glow ashing" to mean if not complete removal of the resist. (Nakamura et al. EP 0247603 at (3/42-46)).** The use of inert gas (nitrogen) during drying is taught by Moe et al. '355 in the cited portions. The applicant's representative misses the mark in describing the source of the corrosive materials on page 8 of the response. They are note produced during the resist formation, but impregnated into the resist during its use as a protective film, during the first etch process, which uses chlorides and/or fluorides. This is fully appreciated in the prior art of Elliot "Integrated Circuit Fabrication Technology" ©1982 and Nakamura et al. EP 0247603. The conventional rinsing and drying after either wet or dry etching is taught on page 267 of Elliot "Integrated Circuit Fabrication Technology" ©1982 and as is the use of drying. The applicant has not shown that the processes that they use differ from the conventional rising and drying steps of the prior art in time or effect. **The use of the laminates might render this more critical, but no claim limitations distinguishing the claimed invention from the conventional processes, which would be prudent in any case based upon the teachings of the prior art concerning corrosive residues, along with a declaration evidencing the difference has been presented by the applicant.** The applicant apparently has forgotten that Al and Al alloys are embraced by the claims, please see claim 66 and clearly undergo corrosion as evidenced by the prior art. The oxygen plasma and dry resist stripping are taught by of Elliot "Integrated Circuit

Fabrication Technology" ©1982 contrary to the applicant assertions. . The conventional rinsing and drying after either wet or dry etching is taught on page 267 of Elliot "Integrated Circuit Fabrication Technology" ©1982 and as is the use of drying which lends itself to combination with the teachings of Moe et al. '355. The examiner notes that composites are taught in Peterman et al. '252 and that the Board of Appeals has seen this reference. The examiner notes that corrosion appears to be a prevalent problem and that the combination of the after treatments of the claims rendered obvious by the prior art all appear to be appreciated as reducing corrosion in the prior art. The rejection stands.

With respect to the arguments of the applicant filed 4/28/2003, the examiner disagrees noting that the issue of minimization of exposure to the atmosphere and the removal of any corrosive residues is well established in the art applied in the rejection and actively voiced in the rejection. There is nothing new there. While the claims differ slightly from those reviewed by the board of appeals in the parent application, 08/470443, the board supported the examiner's position. The use of heated nitrogen to dry the wafers clearly implies that the nitrogen is dry and that moisture is limited. The transfer between chambers under vacuum or in an inert atmosphere is also clearly taught and understood to exclude moisture [where the substrate is transferred under an inert gas atmosphere or vacuum from the first etch apparatus to the second. (Nakamura et al. EP 0247603 at 3/27-53)]. With respect to the arguments that the specification provides data concerning unexpected results, this is an unsupported statement and the specificatiopn on page 50 at lines 9-13 clearly indicates that laminate and alloy (single layer) wiring both suffer from the same problems. The examiner notes that the problem is one recognized in the art as relating to aluminum wiring and all that differs is the severity of the problem when other metals are present.

Therefore the problem and its solution are both fully recognized in the art. In the header, the phrase "as applied to claims cited above, and further" is superfluous, but hardly misleading. The applicant misunderstands how the resist functions. It is coated on the surface of the wiring (laminate) and when developed, portions of the resist are removed. Therefore the sidewalls are never in contact with the resist as it is applied prior to the etching, which exposes the sidewalls of the laminate. The etchant is able to etch any underlying materials through these openings. The resist is the only element of the claim, which might be construed as a protective layer and it's function is well understood as preventing areas of the underlying substrate from being etched. The applicant should understands that the resist is a single layer and there is no other "protective layer" provided on it. The applicant might review Elliott's figures 2-25 and 2-26, which show the devoped resist on top of the aluminum and the subsequent transfer of the resist pattern into the aluminum film by etching. This is clearly a patterned etch rather than the "blanket etch" argued by the applicant. *The issue of Hoch as argued by the applicant fails to apply as the statement of rejection recites each reference applied (see boldface above in the statement of rejection).* ***With respect to the limitation of a single sample processing apparatus. The examiner has interpreted the scope of this to embrace a production line, if the applicant has the intension of limiting the claims to the case, where the chambers are attached as shown in figures 3 or 11 of the instant, then the claims should actively recite this.***

In response to the arguments, the examiner agrees that the **CF_4 etch (1) is a blanket etch**, but holds that the **CCl_4 etch** of the aluminum is a patterned etch. (see figure 2-26 on page 57 referring to an aluminum etch). The applicant may be misinterpreting the discussion or referring to the first etch in the arguments. The process argued by the applicant would not

result in a patterned aluminum layer (ie not circuitry traces/ patterns would be formed). Clearly, the process to be useful in forming a circuit as set forth in the title of the book would have to form a pattern in the aluminum. The etching with CCl_4 etch is a reactive ion etch, not a sputter etching process. The plasma generates radicals and ions from the CCl_4 and these react with the aluminum to form a volatile species (aluminum chlorides and silicon chlorides for AlSi, see page 2/lines 12-28, Nakamura et al. EP 0247603) which is then removed by the pumps maintaining the vacuum in the chamber. The oxygen etch (ashing, stripping is the term used by Nakamura EP 0247603) is used to remove **all** the resist, including that on the sides of the patterned layer. The use of the stripping/ashing/ oxygen plasma etch is disclosed by Elliott as being most desirably carried out immediately to remove any adsorbed free radicals (sentence bridging pages 273-274). The use of a wet aluminum etch after the dry etch process described in steps 1-4 of Elliott is also disclosed. (page 273). After wet etching processes the wafers are rinsed and dried (page 57, Elliott). **The process of the applicant does not preclude a wet etch of the aluminum between the oxygen etch/ashing stripping of the resist and the rinsing step.** Nakamura et al. Also describes the transfer from one etch chamber to the next without exposure to the air to avoid the reaction of chlorine residues with water in the air. (3/44-46). **While the reactivity may be amplified due to the use of a laminated trace material, the effect of residual etchants is already known for aluminum as is the process for removing them by immediately transferring under vacuum to a chamber for ashing/stripping the resist using an oxygen plasma after the reactive ion etch process, followed by wet etching, rinsing and drying aluminum containing traces/circuit patterns based upon just these two references, therefore the assertion on page 14 of the response that the applicants have discovered this**

treatment is unsupported. The Boswell '935 reference discloses that when using an RF bias applied to the substrate of the material being etched, the degree of the anisotropy of the etch may be controlled which is clearly a benefit to forming the desired patterns and is clearly combinable with other RIE processes using CCl_4 based upon the disclosure within Boswell '935 to use it with these gasses. Moe et al. '355 further supports the teachings of conventionality of drying with nitrogen or dry air after stripping the resist from the wafers and rinsing by Elliot "Integrated Circuit Fabrication Technology" ©1982. **With respect to the rinsing and drying steps process, the applicant has not included any limitations in these steps, which distinguishes them from the conventional.** The applicant rinses with water as do the references of the prior art. There is no language indicating any sub steps beyond the basis rinsing and drying, which are not taught in the prior art. Nitrogen is an inert gas ([0114] in prepub of the instant application. The rejection stands.

4 Claims 8-15,17,27 and 67-68 are rejected under 35 U.S.C. § 103 as obvious over Elliot "Integrated Circuit Fabrication Technology" ©1982 and further in view of Nakamura et al. EP 0247603, Moe et al. '355, Peterman et al. '252, Boswell '935 and Noguchi et al. '678

Noguchi et al. '678 teaches the use of two etch chambers connected to each other via a vacuum antechamber (50). The first etch chamber is use to dry etch aluminum or the like using halide gasses (RIE etching) and the second is used to oxygen plasma ash/etch the resist, thereby removing it and halide contaminants. The care taken to prevent contact of the etched substrates with water or air during the transfer to the post treatment chamber is disclosed (1/30-67 and 2/28-43). This is illustrated in figure 2.

In addition to the basis provided above, it would have been obvious to use two etch chamber mechanically linked to etch other as taught by Noguchi et al. '678 in the process of Elliot "Integrated Circuit Fabrication Technology" ©1982 as modified by Nakamura et al. EP 0247603, Moe et al. '355 and Peterman et al. '252 with a reasonable expectation of achieving the desired transfer between the etch chambers without air/atmospheric contact based upon the teachings of Noguchi et al. '678 to that effect.

In addition to the basis provided above, the examiner points to Noguchi et al. '678, who teaches that care is taken to prevent contact of the etched substrates with water or air during the transfer between chambers (1/30-67 and 2/28-43).

The rejection stands for the reasons above beyond pointing to the use of coupled chambers for different etches with a vacuum chamber between them.

5 **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

6 Any inquiry concerning this communication or earlier communications from the examiner should be directed to Martin J Angebranndt whose telephone number is 571-272-1378. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Martin J Angebranndt
Primary Examiner
Art Unit 1756

04/07/2004